Chapter 2

A Proposed Neurodynamic test of the Mandibular Nerve.

Reliability and Reference Values.

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ABSTRACT

Just as other nerves, cranial nerves have need to adapt when movement affects their adjacent structures. One of the cranial nerves subject to mechanical loading is the mandibular nerve, a branch of the trigeminal nerve. This article describes a proposed neurodynamic test for this mandibular branch. The neurodynamics are assessed by performing a lateral gliding movement of the mandible in a combined position of upper cervical flexion and contralateral lateral flexion. In this study, two manipulative physiotherapists performed the test on 24 healthy subjects and 26 patients with craniofacial pain, resulting from a whiplash injury. The localisation, intensity and quality of sensory responses and the available range of motion were analysed. The intertester reliability was good to excellent for most of the parameters examined and normal responses were recorded. The reliability of the therapists' assessment of the experienced resistance during the lateral glide movement of the mandible was poor.The average range of the lateralglide of the mandibula was 21.07 mm in the neutral and 22.37 in the neurodynamic position which was a statistically significant difference . There was a significant increased resistance registrated(from intermediate to mediate)by the manipulative physiotherapist and the sensory responses in neurdynamic position were most evoked in the facial region(mandibular section) and were described with " stretcing or "pulling" with an average intensity on a VAS score of 2.56(1.11 SD) for the left and 2.62 (1.19 SD) for the right side.Further anatomical and clinical research is necessary to further indicate the clinical relevance of this new neurodynamic test.

INTRODUCTION

In the last twenty years there has been a growing tendency to diagnose complaints concerning the craniocervical and craniofacial area as atypical facial pain(Zakrzewska & Hamlyn 1999). Clinicians, manipulative physiotherapists included, are more often faced with these types of complaints due to difficulty in accurate diagnosis (Zakrzewska 1995). Moreover, there is an growing awareness of the multistructural nature of complaints in the cranial and cervical area. (Leone et al 1998).

During the clinical reasoning process when formulating hypotheses for the possible origin of complaints in the cranial and cervical area, the cranial nervous system, a moving painsensitive organ, is often overlooked (Butler 1991; Wang 1998). However, the occurrence of movement and compression of intracranial and extracranial nervous tissue during head-, neck- and jaw movements has long been reported in literature in the field of plastic surgery, neurosurgery, orthodontics and neurology (Janetta 1982; Barba et al 1984; Sessle 1993).

An example of cranial nervous tissue that must adjust to its changing surroundings is the fifth cranial nerve,the trigeminal nerve(V). In particular its third branch,the mandibular nerve(V3) is strongly predisposed to neuropathy (Shankland 1995; Hughes 1993). For this reason, it would seem appropriate to develop a clinical test for this cranial nerve, analogous to the neurodynamic tests for the lower and upper extremities. Prior to discussing this neurodynamic test, a short description is given of the relevant anatomy of the mandibular nerve and the impact of head-, neck- and jaw movements concerning this cranial nerve branch.

ANATOMY AND NEURODYNAMICS

The trigeminal nerve emerges on the midlateral surface of the pons as a large sensory root and a smaller motor root (Wilson-Pauwels et al 1988). Its sensory ganglion, the trigeminal ganglion, is located in the trigeminal cave at the base of the middle cranial fossa. The three major divisions, the ophthalmic (V_1), maxillary (V_2) and mandibular (V_3) nerve, originate distally from the ganglion (Fig. 1). The mandibular nerve exits the skull through the oval foramen, located in the greater wing of the sphenoid bone. As it leaves the cranial cavity, it branches extensively into several sensory and motor nerves. The major sensory branches are the auriculotemporal, lingual, inferior alveolar, buccal and meningeal nerve. Sensory information from the area of the cheek, including the mucous membrane of the mouth and gums, is carried by the buccal nerve. The auriculotemporal nerve innervates the side of the head and scalp, the external auditory meatus, tympanic membrane and temperomandibular joint. General sensation from the entire lower jaw, including teeth and gums, and the anterior two-thirds of the tongue is carried in two major nerves, the lingual nerve and the inferior alveolar nerve. Sensory branches from the chin and lower lip converge to form the mental nerve, a branch of the inferior alveolar nerve. Finally, the meningeal branch of the mandibular nerve carries sensation from the meninges of the anterior and middle cranial fossa. The motor branches of the mandibular nerve are amongst others responsible for innervating the mouth floor and the masticatory muscles (Lang 1995; Le Blanc 1995; Wilson-Pauwels et al 1988). The mandibular nerve passes through various tunnels, has several anastomosis and divisions and is fixed to the mandible at various sites (Isberg et al 1987). These characteristics is often a predisposition to the development of peripheral neurogenic dysfunctions (Butler 1991; Hall et al 1998). It should be noted that trigeminal neuralgia is observed more frequently in the mandibular nerve than in the ophthalmic or maxillary nerve (Zakrzewska 1995). Also, the mandibular nerve and its various branches may display several anomalies. For instance, the lingual nerve may pass through the muscle belly of the lateral pterygoid muscle (Isberg et al 1987) (Fig. 2), which, in the event of an imbalance of the masticatory muscles, may lead to an entrapment (Okeson 1995). Another possible location for the incidence of an entrapment is the mandibular canal through which the inferior alveolar nerve runs (Williams et al 1989). Also, an accelerated denervation of the mandibular nerve has been reported (Okeson 1995), causing abnormal impulse generating sites (AIGS) which are generations of abnormal impulses along the nerve (Devor&Rappaport 1990) These AIGS can be stimulated by trauma ,poor metabolism (e.g. diabetes) , tcatacholamines(neurotransmitters of the sympatical nervous system), change in temperature and mechanical stretch (Marbach 1993; Devor 1994).

Various movements of the head, neck and jaw have impact on the mandibular nerve (Dimitroulis 1995). Upper cervical flexion, for example, causes an increased tension in the dorsal meninges, cranial nerves and blood vessels in the dorsolateral and midlateral part of the brain stem (Breig 1978; Janetta 1982; Lang 1995; Doursounain 1989). The movement and mechanical loading of the trigeminal nerve at the brain stem is further increased by an upper cervical contra lateral- flexion (Barba et al 1984; Browsher 1988; Koos & Spetzler 1993). During lateral glide of the mandible a tension is created in the auriculotemporal nerve, the inferior alveolar nerve and the lingual nerve (Liguori et al 1998; Ethunandan 1999). The strongest mechanical loading during lateral glide of the mandibula occurs at the contralateral side (Schmidt et al 1998; Tellioglu et al 2000). During a maximal active opening of the mouth the inferior alveolar nerve should increased length of about 8 mm in relation to its surroundings (Lougner et al 1990; Rosenquist 1996).

The above findings lead to the development of a neurodynamic test for the mandibular nerve. Neurodynamic tests depend upon lengthening of the nerve bed being examined (Elvey 1979;Butler 1991). Therefore a protocol in which sequence movements has to be performed which lengthen the mandibular nerve as a proposed neurodynamic test are described in the next section. (Von Piekartz 2000). The object of the research part of the study is to test the reliability of the proposed neurodynamic test of the mandibular nerve on a mixed group of subjects without and patients with craniofacial problems. Furthermore, the results from the subjects without craniofacial problems will be used to propose a number of reference values including range of motion , resistance and sensory responses during the lateral gliding of the mandible in neurodynamic position.

METHODS

Test description

In the starting position, the patient lies supine on a plinth, the arms by the side and the hands on the abdomen. The patient's head is positioned over the end of the plinth and rests against the clinician's abdomen. The clinician supports the patient's head with both hands at the occipital area and places both thumbs on the mandibular angles. By tilting the patient's head, the clinician performs an upper cervical flexion through an imaginary transverse axis, which runs between the first and second vertebra. In addition, by moving the trunk laterally, the therapist performs a contralateral side flexion of the upper cervical spine through an imaginary sagittal axis, which runs between the first and second vertebra. Both cervical movements are performed as far as possible to optimally load the intracranial structures, but without provoking any pain or discomfort. While maintaining this position, a lateral glide movement of the mandible towards the contralateral side is performed. The clinician's index and middle finger are positioned parallel to the mandible, the metacarpophalangeal joints lying caudolateral to the corner of the mouth and both fingers pointing ventrally. The patient's masticatory muscles and tongue must be relaxed during the lateral glide movement. It is recommended to perform the lateral glide movement with a mouth opening of approximately one centimetre, because the range of lateral glide is maximal in this position (Kraus 1994;Dimitroulis et al 1995). For structural differentiation, the lateral glide movement of the mandible in the combined position of upper cervical flexion and contralateral side flexion can be compared with a lateral glide movement with the cervical spine in a neutral position, while neural structures are not preloaded.

As in other neurodynamic tests, the clinician monitors the range of motion, resistance, endfeel and reproduction of symptoms, which contribute to the interpretation of the test (Elvey 1979; Butler 1991).

Subjects and groups

A total of 50 volunteers participated in the study, 26 patients with post-whiplash symptoms and 24 subjects without craniofacial problems.

The patient group ,17 female and 9 male, mean age 34.2(SD ± 5.8) years had a diagnosis of post-whiplash syndrome that was present for over three months. Further to complaints of the neck and headaches these patients reported also facial symptoms.

The healthy group comprised 15 females and 9 males with a mean age of 31.6(SD ± 6.3) years. Subjects were excluded if they had a history or present medical record of complaints concerning the cervical spine, head or jaw region. Tension headache and migraine according to the criteria of the International Headache Classification (ICH) (Olesen 1988) and the International Association of the Study of Pain (IASP) (Merskey & Bogduk 1994) were also considered exclusion criteria.

Assessors

Two manipulative physiotherapists with more than five years clinical experience performed the tests. The test was demonstrated to the two therapists three times and, if necessary, the two were individually corrected. Prior to the study, the therapists were enabled to train and perform the test on 50 subjects including patients with craniofacial complaints.

Apparatus and measurements

To achieve an optimal standardisation in the experimental set-up a number of aspects were added to the test procedure mentioned above. The subject was lightly fixed under the axilla by means of a fixation belt for optimal standardisation(Fig. 3A) to prevent lateral flexion of the trunk (Yaxley & Jull 1991). Prior to performing the lateral glide movement, a 10-mm wide spatula was used to standardise the mouth opening (Fig 3B). The amplitude of the lateropulsion was measured by means of an electronic digital calliper (Pro-fit 2520 150 D, Mitutayo Ned B.V., Veenendaal, The Netherlands) with an accuracy of 0.03 mm (Fig. 3c).

The sensory responses triggered during the test were assessed on localisation, quality and intensity. The localisation was indicated on a topographic chart, subdivided into 4 primary regions: (1) auriculotemporal (AT), (2) facial (F), (3) cervicocranial (CC) en (4) intraoral (IA) and 12 subdivisions (Fig. 4a and b). The analysis was restricted to the sensory responses evoked at the examined side. Using a questionnaire containing a list of responses most frequently reported in a pilot study among symptomatic and healthy volunteers, an inventory was made from the quality of the responses. The intensity of the most explicit response was marked on a visual analogical scale on which the ends were defined as “no pain” and “worst pain conceivable” (Colins 1997; Jensen et al 1992).

Because different sensory responses have often been reported for neuropathies in the face (Zakrzewska & Hamlyn 1999), we also registrated sensory responses in the head-, neck- and face region during and after testing. The quality of the resistance felt by the therapists during lateral glide was marked on a four-point scale: “minimal”, “intermediate”, “moderate” and “strong”, visually shown by means of movement diagrams (Fig. 5) (Maitland 1986; Magary 1986). For this the following captions were used. The initial resistance of the passive lateral glide is R1 and the final resistance is R2. This is also the limit of the movement (L). The BC line (Fig. 4) is the "mean" limit of the lateral glide as anticipated by the therapist (Maitland 1986). "Minimal resistance" was used if the initial resistance (R1) started prior to the "mean" limit and R2 exceeded this. The resistance was called "intermediate" if R1 started after half of the mean range of motion and R2 coincided with the "mean" limit. "Moderate resistance" was used if R1 occurred in the first half and R2 occurred between the second half and the "mean" limit. If R1 and R2 both occurred in the first half of the motion range, "strong resistance" was marked.

Procedure

The test design was blinded. The subject was positioned supine on a plinth and the first therapist performed a lateral glide movement of the mandible with a mouth opening of 10 mm and the cervical spine in a neutral position (physiological lordosis of the cervical spine). The subject was positioned in the neurodynamic test position (upper cervical flexion and contralateral side flexion) and the lateral glide movement of the mandible was repeated. This was done for the lateral glide movement towards the left and the right side. The range of motion was measured in the neutral position and the resistance was assessed in the neurodynamic position. The localisation, quality and intensity of the sensory responses were assessed before and after the test . After an interval of at least 20 minutes, the second therapist repeated the same protocol.

STATISTICAL ANALYSIS

Reliability

To determine a measure of inter-tester reliability for the extent of lateral glide in the neutral and neurodynamic position, the ICC (2,1) (Intraclass correlation coefficient) was calculated (Shrout & Fleiss 1979). For the non-parametric variables (localisation of the sensory responses and the extent of the resistance) a “weight” Cohen’s kappa (K) was calculated (Safrit & Wood 1989; Lanz 1997). The value of Cohen’s kappa may vary between 1 (perfect agreement) and 0 when the proportion of observed agreement equals the proportion of change agreement. The following categories were adopted for the interpretation of the Kappa coefficients: ‘excellent’ = $K \geq 0.75$; ‘fair to good’ = $0.75 > K \geq 0.40$ and ‘poor’ = $K < 0.4$ (Fleiss 1981). Because a sufficient spread in the distribution of scores was sometimes lacking, the percentage of agreement was assessed as an alternative (Hendriks et al 1997). In the absence of criteria relating kappa for the skewness of observations (Hendriks et al 1997), the guidelines proposed by Van Triet et al (1990) were adopted. Kappa was not calculated if the content of one of the cells in the contingency table was larger than 90% or less than 10%. In this case, only the percentage of agreement is reported, but these latter values may be inflated by accidental agreement and should be interpreted cautiously. When the cell content varied between 10% and 20% or between 80% and 90%, the kappa values are reported, but should also be interpreted cautiously, because they do not necessarily reflect the agreement that can be observed in a more diverse group.

Reference values

The reference values (range of motion of the lateral glide movement of the mandible, sensory responses and resistance during the lateral glide movement) were assessed on the basis of the results from the 24 healthy subjects. Differences in the extent of lateral glide in the neutral and the neurodynamic position were analysed with a paired t-test. The significant level was set at 0.05.

RESULTS

Reliability

Range of motion

The ICC (2,1) coefficients for the inter-tester reliability for the range of lateral glide movement of the mandible in the neutral position were 0.72 for the leftward movement and 0.79 for the rightward movement. In the neurodynamic test position, coefficients were 0.77 and 0.90 respectively.

Sensory responses

Table 1 indicates the reliability of the localisation and the responses evoked for the various cranial regions and subdivisions. The kappa value ranged between 0.61 and 0.96 and the percentage of agreement between 82 % and 100 %.

Resistance

For the two therapists the percentage of agreement for the assessment of the quality of resistance of the lateral glide movement of the mandible in the neutral position was 66 % for the left and 60 % for the right lateral glide movement (Table 2). In the neurodynamic position the percentage of agreement was 72 % and 56 %, respectively. The kappa value in the neutral position was 0.38 for the left and 0.35 for the right lateral glide movement. In the neurodynamic position the kappa was 0.49 and 0.28 respectively.

Reference values

Range of motion

In the healthy group, the average range of lateral glide movement of the mandible in the neutral position was 21.11 mm (SD ± 2.14) to the left and 21.03 mm (SD ± 2.77) to the right. In the neurodynamic position, the range of lateral glide movement was 22.31 mm (SD ± 2.48) and 22.44 mm (SD ± 2.37) for the movement to the left and the right side, respectively. There was no significant difference in the range of motion between the movement to the left and right side in the neutral position (P = 0.75), nor in the neurodynamic position (P = 0.69). A paired t-test was been used. Results of the statistical analysis demonstrated that differences between the neutral and neurodynamic position were significant (left: P < 0.001 and right: P < 0.001).

Sensory responses

Table 1 presents an overview of the percentages of responses in the various cranial regions and subdivisions in neurodynamic position

In all subjects no sensory responses were registrated in neutral position.

The sensory responses in neurodynamic position occurred in three of the four primary regions, i.e. in the auriculotemporal, facial and cervicocranial region. Sensory responses were evoked most frequently in the facial region: all persons reported responses in this region; both for the left and the right lateral glide movement. In this area, the sensory responses occurred predominantly caudally from the temperomandibular joint up to the mandibular angle. In subjects of the control group were no responses distally from the mandible angle. For the leftward test, three subjects (12.5 %) reported symptoms in the auriculotemporal area and for the rightward test only one subject (4.2 %) reported these symptoms. The symptoms were predominantly localised at the temperomandibular joint. In one subject (4.2 %) craniocervical responses were evoked and in the healthy group there were no intra-oral complaints. There were any sensory responses after termination of the test or did any symptoms develop after termination of the manoeuvre.

When asked to indicate the quality of the sensory responses, the subjects usually described the symptoms in the various regions as “stretching” or “pulling”. Sometimes, the term “burning” was used.

Usually, the intensity of the responses was rather low. The mean VAS score for the most explicit response during the neurodynamic test was 2.56 (± 1.11) for the left and 2.62 (± 1.19) for the right lateral glide movement of the mandible.

Resistance

The assessment of the resistance experienced by the therapists is shown in table 2. In the neutral position the resistance was mainly called “intermediate” and in the neurodynamic position it was dominantly called “intermediate” or “moderate”.

DISCUSSION

Reliability

For both the range of motion and the triggered sensory responses during the neurodynamic test for the mandibular nerve, the reliability was good. The ICC coefficients and the kappa values were good to excellent (Fleiss 1981) and the percentages of agreement were higher than could have been expected on the basis of a mere coincidence, as was the case in other passive manual tests assessment of resistance presented difficulties (Maher 1994,1995;MacDermid et al 1999). Although the reliability of the assessment of the resistance is better that was expected the reliability tends to be poor. Therefore, the experienced resistance will not be discussed further in this article.

Reference values

Range of motion

The mean range of the lateral glide of the mandible was 21.07 mm in the neutral position and 22.37 mm in the neurodynamic position. Although this was a statistically significant difference, from a clinical point of view this difference in amplitude seems only slight. However, contrary to our expectation, there is no significant reduction of the movement deflection in the neurodynamic position. In this respect the results of the neurodynamic test for the mandibular nerve differ from the slump test and the neurodynamic test for the upper extremity (median nerve). The addition of sensitising movements had a significant effect on the range of motion, even in the subjects without complains (Johnson & Chiarello 1997; Coppieters et al 2000). A change in position of the head of the mandibula in the mandibula fossa as a result of the cervical flexion is a possible explanation for these findings (Rocabado 1983; Darling et al 1984). Further research in patient groups might demonstrate the added value of the combined position of the cervical spine in the neurodynamic position but also other neurodynamic tests like SLR or Upper limb Neurodynamic Tests(ULNT) can be make sense

Sensory responses

As in other neurodynamic tests (Kenneally 1988), the mandibular nerve test also triggered sensory responses in healthy subjects. Since responses in the facial region were evoked in all subjects, the responses in this area must be considered normal during the performance of the neurodynamic test of the mandibular nerve, especially if the symptoms are limited to a stretched feeling in the area between the temperomandibular joint and the mandible angle. When the symptoms were triggered in the auriculotemporal region, it usually concerned the region of the temperomandibular joint. Only one subject indicated symptoms in the cervicocranial region and none of the subjects experienced intra-oral responses. Any symptoms during the test in these regions must therefore be considered as an abnormal response. It should also be noted that if responses were triggered, they had a low score on the VAS intensity were usually described as a feeling of “stretch”. High VAS scores and quality of symptoms such as “numbness”, ”pins and needles", "burning” and extreme “pressure” must therefore be considered as abnormal.

Limitations of the study and recommendations for future research

In all subjects, the lateral glide movement in the neutral position was performed prior to performing the neurodynamic test. This implicates that some of the findings, e.g. the larger range of motion in the neurodynamic position, might be due to order effects.

During the research lateralglide of the mandibula is only tested in two cervical position which is based on anatomical extrapolation and clinical evidence. Further sensitizing manoeuvres like SLR and shoulderdepression can help to clarify wether this test is fair stressing neural tissue. The methodology about resistance reliability is maybe to complicated during this research. The 4 pointscale with too much subitems(R1,R2, L etc) can be simplified to 2-3 pointscale without subitems.
During the statcical analysis the result of the left and right side are seperated. In the next research both side can be calculated together.

CONCLUSION

This proposed neurodynamic test for the mandibular nerve,a combination of two upper cervical movements together with one mandibula movement,has a good reliability.

However, it should be emphasised that various structures are affected during the test and that up to now, it is impossible to state which structures are responsible for which responses. Therefore, the results should be interpreted with caution and has to been seen as a pilotstudy. Further analysis with addition of other neurodynamic position like SLR,shoulderdepression and ULNT s must indicate possible differences between patients with obvious mandibular neuropathy and subjects without neck-, head and face pain. Differences in symptom distribution, intensity of the pain and/or range of motion of the mandible might contribute to the validation of the test.

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Table 1 Reliability and reference values for the localisation of the sensory responses

	Reliability				***Reference values***	
	Left		Right			
	K	% agreement	K	% agreement	Left	Right
A. AT-region	0.88	94 %	0.84	92 %	12.5 %	4.2 %
- intra auricular	0.84	92 %	0.63	82 %	12.5 %	4.2 %
- peri auricular	-	90 %	-	96 %	4.2 %	0.0 %
B. F-regio	0.92	96 %	0.88	94 %	100.0 %	100.0 %
- mandibula (till mandibulae ang.)	-	94 %	-	96 %	75.0 %	83.3 %
- mandibula (futher as mandibula ang.)	-	94 %	-	88 %	0.0 %	0.0 %
- maxilla	-	98 %	0.90*	98 %	0.0 %	0.0 %
- orbita	-	96 %	-	96 %	25.0 %	33.3 %
- temporal	-	94 %	-	98 %	33.3 %	41.7 %
C. CC-region	0.80	90 %	0.83	92 %	4.2 %	4.2 %

- trapezius	-	86 %	0.65*	90 %	0.0 %	0.0 %
- cervical	0.61	86 %	0.68	84 %	4.2 %	0.0 %
- dorsol auricular	0.80	90 %	0.96	98 %	4.2 %	4.2 %
- cranial (dorsal)	0.94*	98 %	0.91	96 %	0.0 %	4.2 %
D. IO-region	-	98 %	-	98 %	0.0 %	0.0 %
E. Symptoms after 10 seconds						
- absent	0.91	96 %	-	100 %	100.0 %	100.0 %
- manifest	-	84 %	-	94 %	0.0 %	0.0 %

AT = auriculotemporal; F = facial; CC = cervicocranial; IO = intra-oral; Κ = kappa; % agreement = percentage of agreement; dash (-) indicates that kappa was not calculated (cel content < 10% or > 90%); Asterisk (*) indicates that kappa should be interpreted with caution (cel content between 10% and 20% or between 80% and 90%). Note that the reliability was calculated on the data of a mixed group of 26 patients and 24 asymptomatic subjects and that the reference values were calculated on 24 asymptomatic subjects.

Table 2 Reliability and reference values for the judgment of the quality of resistance during the lateropulsion movement of the mandible

	Left		Right	
A. Neutral position				
I. Reliability		% agreement		% agreement
	0.38	66 %	0.35	60 %
II. Reference values				
- minimal resistance	0.0 %		4.2 %	
- intermediate resistance	66.7 %		62.5 %	
- moderate resistance	29.2 %		29.2 %	
- strong resistance	4.2 %		4.2 %	
B. Neurodynamic test				
I. Reliability		% agreement		% agreement
	0.49	72 %	0.28	56 %
II. Reference values				
- minimal resistance	0.0 %		0.0 %	
- intermediate resistance	45.8 %		54.2 %	
- moderate resistance	50.0 %		41.7 %	
- strong resistance	4.2 %		4.2 %	

Κ = kappa; % agreement = percentage of agreement. Note that the reliability was calculated on the data of a mixed group of 26 patients and 24 asymptomatic subjects and that the reference values were calculated on 24 asymptomatic subjects.

FIGURE CAPTIONS

Fig. 1- Course of the mandibular nerve (V_3). (1) Trigeminal ganglion, (2) foramen ovale, (3) auriculotemporal nerve, (4) masseteric nerve, (5) mylohyoid nerve, (6) inferior alveolar nerve, (7) lingual nerve, (8) buccal nerve, (9) deep temporal nerve, (10) otic ganglion and (11) mental nerve. From Piekartz von HJ, Bryden L 2000 Craniofacial Dysfunction and Pain. Manual therapy, Assessment and Management. Butterworth-Heinemann, Oxford

Fig. 2- Anomaly of the lingual nerve (LN) which runs through the lateral pterygoid muscle(LP) MP = medial pterygoid muscle. Reproduced by kind permission of Mosby, Inc. from Isberg AM Isacsson G Williams WN and Loughner BA 1987 Lingual numbness an speech articulation deviation associated with temporomandibular joint disk displacement Oral surgery Oral Medicine and Oral Pathology, 69, 9-14.

Fig. 3- Overview of the experimental set-up (fig 3A), standardisation of de mouth opening with spatula before testing (fig. 3B) and a close-up showing the measurement of the range of lateropulsion using the electronic digital calliper (fig 3C)

Fig. 4- Four different regions were chosen for the analysis of the area of sensory responses (Fig 4A): (1) auriculotemporal, (2) craniocervical, (3) facial and (4) intraoral region (not depicted). 11 Subdivisions were used for more accurate localisation (fig 4B):

Fig. 5- Movement diagrams demonstrating the different categories for the perceived quality of resistance during the test: (1) minimal, (2) intermediate, (3) moderate and (4) strong resistance.

Fig. 1

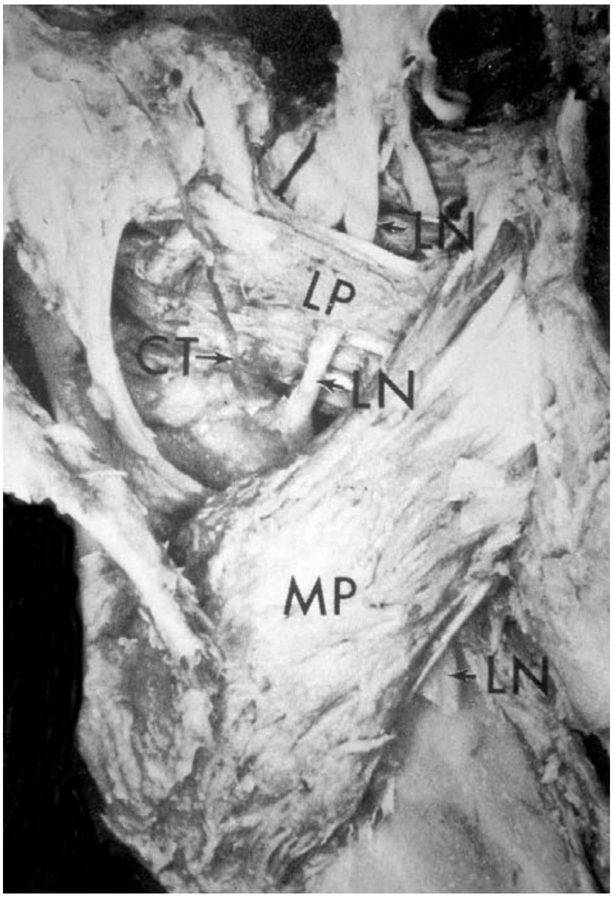


Fig. 2

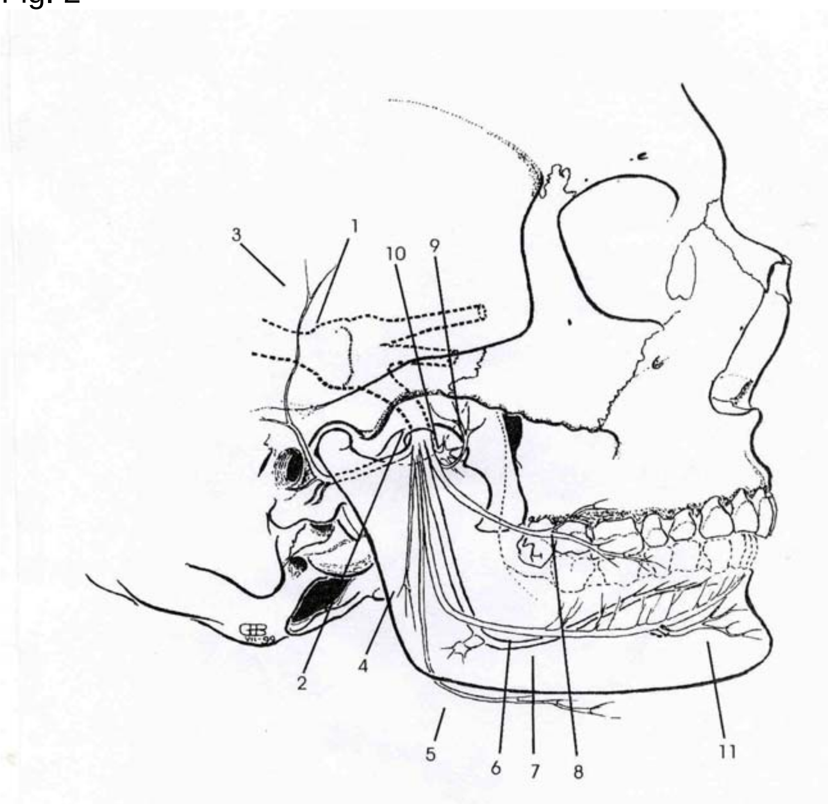


Fig. 3a

Fig. 3b

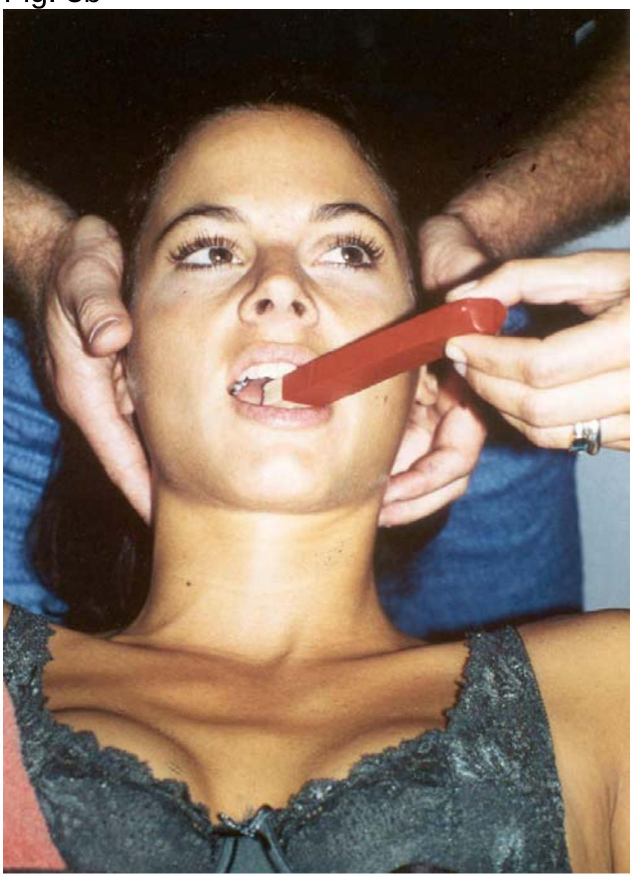


Fig. 3c

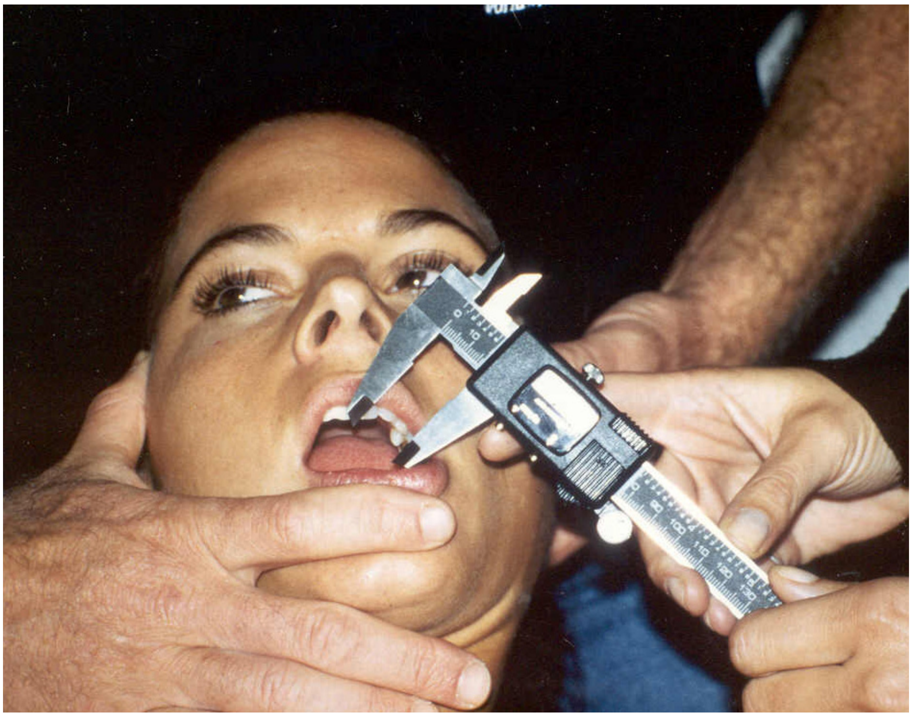


Fig. 4a

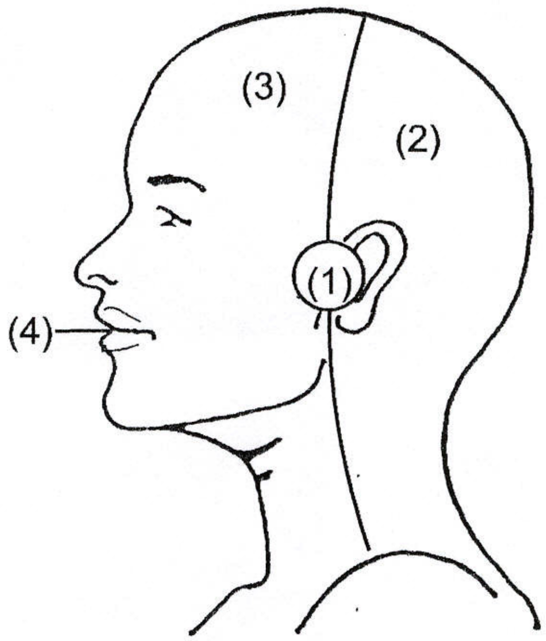


Fig. 4b

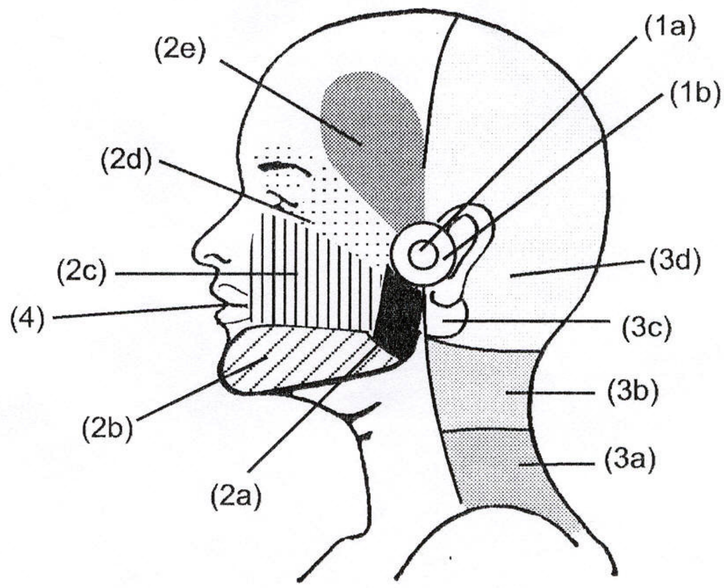
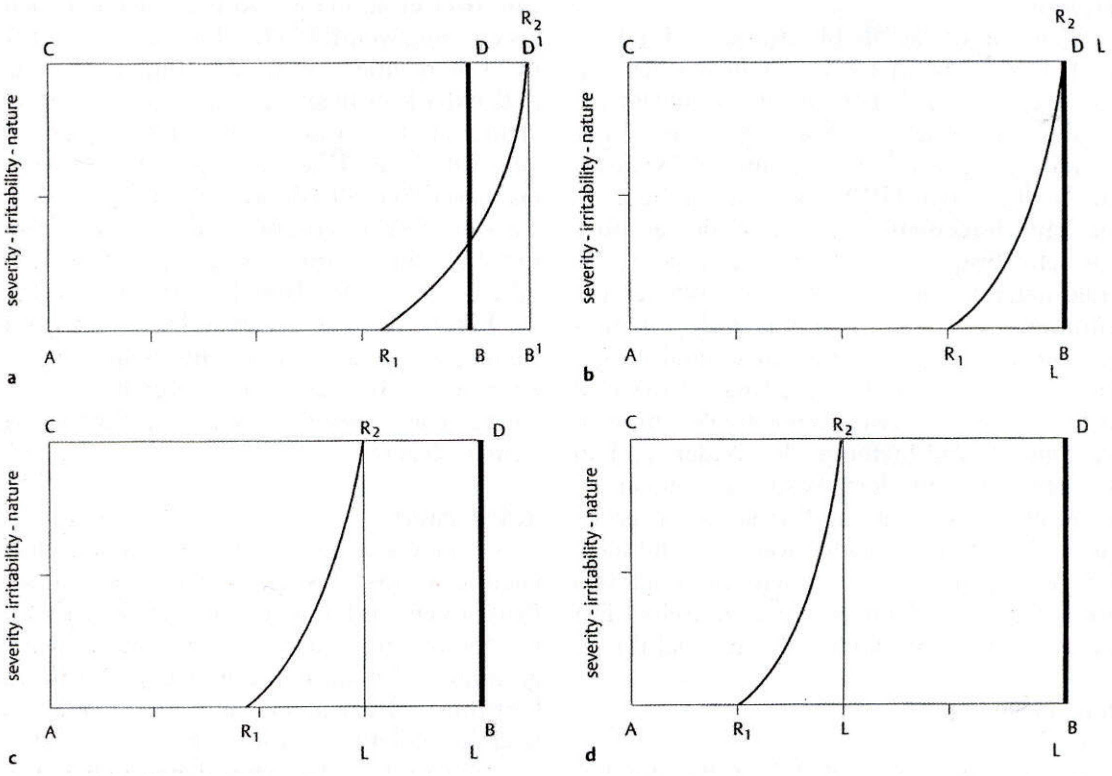


Fig. 5


severity - irritability - nature
A
C
D
R₂
R₁
B
B¹
D¹
L
a
b
c
d